

## Ameritron ARB-704

### IMPORTANT!

- 1.) This manual is for advanced users, who want to wire their own cables. Detailed information in this manual describes input requirements and output limitations of this device.
- 2.) Ameritron also offers prewired plug-and-play cables. If you use prewired plug-and-play cables, you can ignore this manual and use the simple instructions that are included in the plug-and-play cable assembly for your radio.
- 3.) Many radios do not require a plug-and-play cable assembly, and can use basic cables included with the ARB-704. These radios are listed on the plug-and-play sheet included with this unit.

### INTRODUCTION

The ARB-704 advanced interface is compatible with all common radios and amplifiers even though radios and amplifiers do not have standardized voltages, accessory plugs, or wiring. This interface is designed to work with any amplifier/radio combination. The input is designed to be compatible with any transmitter or transceiver, and the output is compatible with AC control lines or DC positive or negative amplifier control lines having up to 200 volts peak open circuit voltage and 300mA of operating current.

Ameritron offers several plug-and-play cables that interface more common radios to the ARB-704. Plug-and-play cables for various radios as well as radios not requiring a special cable assembly are listed on a loose page enclosed in this manual.

### WHY YOU NEED THE ARB-704

Amplifiers can damage radios if the amplifier has too much relay control voltage, voltage spikes, or excessive current on the relay control line. Such damage often appears as "stuck" or "sticky" transmit relays in operation or shorted

transmission on vacuum control lines. In most cases where the radio is damaged, the system transmits normally but the external amplifier stays locked in a "transmit" mode. This prevents receive signals from coming through the amplifier with normal levels whenever the amplifier is in the "ON" or "OPERATE" position.

One protection or buffering system requires installation of a low-current isolation relay between the radio and amplifier. Unfortunately an isolation relay's field coil can still draw appreciable current, and relay coils produce a voltage spike when unkeyed. If a back-pulse canceling diode is installed to suppress back EMF or coil back-pulse voltage, relay release time increases.

Most amplifiers are already margined on pull-in time. Even if current, release time, and back-pulse aren't excessive, closure time is always noticeably increased because of the pull-in time delay of mechanical isolation relays. If the external "isolation relay" adds enough pull-in delay, the radio's output signal can appear before the amplifier's internal relay completely transfers the antenna to the amplifier output. This is called "hot switching", and it can cause serious damage to the amplifier and radio.

Hot switching can destroy an expensive bandwidth or tuning capacitor in the amplifier, as well as cause annoying "clicks" or "pops" outside of your operating frequency. Besides being rough on equipment and annoying to people operating close to your frequency, hot-switching can also mutilate your sending. On CW, the entire first "dot" might disappear...making a call like AA4MM sound like TA4MM.

The ARB-704 has many electrical advantages over conventional relay buffer systems. The ARB-704, since it has no moving parts, switches almost instantaneously. The ARB-704 is noiseless, has very long life, and will not develop dirty contacts. It operates with negative, AC, or positive amplifier relay control lines.

The ARB-704 works with any relay voltage (AC, positive, or negative) up to 200 peak volts and any relay current up to 300mA. The ARB-704 is fully compatible with conventional amplifier relay systems. It is especially suited for buffering vacuum relay QSK amplifiers, since the ARB-704 does not affect attack or release times in a deleterious manner.

The ARB-704 operates with transmitters or transceivers that pull amplifier control lines to ground, or output a wide range of positive or negative control

voltages. The transmitter only switches currents under 0.35 milliamperes and very low voltages when using the ARB-704.

### **WARNING:**

- 1.) *Never use this unit with relay coils operated directly from power lines (such as old amplifiers with external 150 VAC line-powered relays). AC coil relays can be switched if operated from a small isolation transformer.*
- 2.) *This unit is NOT ground isolated. It electrically connects the amplifier relay closure terminal to chassis when activated.*
- 3.) *Equipment damage and shock hazards will be present if you fail to properly connect ground leads to the amplifier and/or radio. Always be sure to connect the additional safety ground lead to the station ground bus from the ARB-704. Always be sure the amplifier ground return and radio ground return leads are connected.*

## **TECHNICAL DESCRIPTION**

The ARB-704 uses four transistors and one operational amplifier. It has a red LED indicator that illuminates when the relay control line is activated. The ARB-704 accepts either traditional low - transmit (TX-SEND) or less common high-transmit (TX-SEND) amplifier control outputs from the radio.

The ARB-704 **RADIO** input current and voltage requirements are minimal. Only a few volts and much less than one milliamperes is required for normal operation. Virtually any radio can directly operate the ARB-704.

The ARB-704's unique output circuit pulls either positive or negative amplifier relay control lines to ground. Nearly any amplifier relay system is compatible with the ARB-704. The ARB-704 can safely handle open circuit voltages up to 200 volts DC or peak AC, and carry relay currents up to 200mA.

## CONNECTIONS

Connect the amplifier control line (often called TX-SEND line) of your radio to the RADIO jack or to pin 3 of the ARB-704 MULTI-PORT jack.

JMP1 and JMP2, located inside the ARB-704, must be positioned to match the type of output from the TX-SEND radio control line. The following control voltage jumper settings are available:

**RADIO (TX-SEND) = Low systems** 2.5 volt threshold (most common system used) 5 volts open-circuit



This system activates whenever the RADIO (TX-SEND) line pulls below approximately 2 volts. Only 100µA of current appears at the output terminal when pulled low, and open circuit voltage is +5 volts. This line is diode blocked, so the radio can pull up to any voltage above +5 volts without any current being drawn from the radio. A pull-down resistance of less than 15k-ohms activates the system.

**RADIO (TX-SEND) = Low systems** 2.1 volt threshold (IC-706 series) 2.5 or more volts open circuit.



This system activates whenever the **RADIO** line pulls below 2.1 volts. Only 100pA of current appears at the output terminal when pulled low, and open circuit voltage is 2.5 volts. This line is diode blocked, so the radio can pull up to any voltage above 2.5 volts without any current being drawn from the radio send line. A pull-down resistance of less than 100k-ohms activates the system.

This system is suitable for rigs like the IC-706, where the "send" line is shared with other radio functions and cannot be loaded.

#### **RADIO (TX-SEND) = Negative system**



This system activates whenever the **RADIO** line goes more than 1 volt negative. Less than 150pA of current is consumed when pulled negative to 5 volts, and open circuit voltage is 2.5 volts positive.

#### **RADIO (TX-SEND) = Positive system**



This system activates whenever the **RADIO** line is pulled above 3 volts. Only 50pA of current appears at the output terminal when pulled low, and open circuit voltage is 2.5 volts. This system consumes 1/2mA of current with 12 volts applied.

**Note:** Most modern transmitters have TE-RFND lines that switch low (to ground) when transmitting. They use settings of J10P1 and J10P2 for reverse normal TE-low keying.

**Exceptions** are transmitters that have very sensitive keying systems (like the IC-700), transmitters that output positive voltage when sending (normal for most radios), and radios having a negative send voltage (some older models).

The AMP jack (J1) is a standard phono (commonly called "RCA") jack. When this unit is properly connected, this jack will pull relay lines with 100 mA of current (typical for most amplifiers) within 0.7 volts of ground. This jack is capable of handling 200 volts of maximum open-circuit voltage. The voltage can be positive, AC or negative. Maximum rated current is 100mA.

The ALC jack is normally connected when using plug-and-play cables, and when amplifier ALC is used. It connects to the amplifier's ALC output. In other cases where amplifier ALC is used, the ALC output from the amplifier can be connected directly to the radio with a standard shielded phono (RCA) connector cable (such as cables used for home stereo and VCR audio lines).

## INSTALLATION

The ARB-704 requires external voltage to operate. This voltage can be obtained from any filtered 9-18 vdc dc supply capable of supplying up to 50 mA.

Some radios have variable operating voltage available on the same radio connector used for control line and ALC connections. In such cases, power is obtained from the radio's accessory or control jack through plug-and-play cables and no other connections are required. In other cases, power can be obtained either from the 12-volt station power supply or through a separate wall adapter (also called a "wall-wart"). Amphenol offers a 12-volt wall adapter, Model: MP1-1313.

### WARNING:

Never connect the power jack to a voltage source capable of supplying more than one ampere without proper fuses. Use a 1/4 ampere fast-blow fuse to protect the wiring and your power supply from accidental short circuits.

When unplugged, the standard 12-volt plug used with this unit can accidentally come in contact with other devices that may be damaged by excessive current. Always disconnect the power source end of the power cable first, then the power supply end, before removing or inserting the power connector into the ARB-704. Never insert or remove the power plug from the ARB-704 while power is on.

Never use power from the radio and power from an external adapter at the same time.

Always be sure the red lead is positive, and the black lead is grounded. Reversing the leads may damage the ARB-704, the radio, or the power supply.

#### **RELAY control:**

Virtually all transmitters or transceivers have an internal relay that can be used to ground the amplifier's control line. The radio's manual will show a set of contacts in a simple diagram, or have the jack labeled NO (normally open), NC (normally closed), and COM (common). At other times transmitter control connections are labeled: Transmit, T or TX, Receive, R or RX, and C or common.

In most radio transceivers, the NC (normally closed) contact is often omitted. The NC contact was commonly used to control muting (standby) of external receivers, such as old tube-type equipment like Drake Twins or Collins 12/13 series.

#### **TRANSISTOR control:**

Some transceivers use a transistor for external amplifier control. The transistor normally pulls to ground (low) on transmit.

#### **VOLTAGE control:**

A few radios use voltage to switch external amplifiers. The IC-706 is a current example of this. In the IC-706, voltage on a very low current control pin drops

low when transmitting. This line cannot be loaded with more than a few mA of current draw, nor can external circuits try to force this line higher than a few volts. If these precautions are not heeded, the radio will not work properly or may be damaged. The ARB-704 is designed to function perfectly with the IC-706.

## WIRING

Many radios and most amplifiers have standard RCA phono jacks for TX SEND connections. When radios have phono plugs, connections can be made using common home stereo or VCR system audio cables. It is NOT necessary to run the ALC line through the ARB-704. The ARB-704 only provides a straight-through ALC connection for convenience when using Amateur's plug-and-play radio cables.

To wire or connect your own cables, use the radio manual's section on external power amplifier or necessary connections that describe transceiver or radio connections to external power amplifiers. The drawing will typically show a relay contact connection described as NO, SEND, or TX (transmit) for external amplifier control. On some radios you may have to set a switch inside the radio. The FT1000D is one radio that requires changing an internal switch to activate the external relay. The radio's manual, in the section describing use of external power amplifiers, will tell you if changing a switch is necessary.

The NO or TX-SEND connection on the radio wires to the center pin of the **RADIO** female phono (RCA) lead of the ARB-704, or to pin 3 of the ARB-704 DIN connector.

If the transceiver or transmitter has an internal relay with a contact marked COM or C, connect this pin to the shell of the ARB-704 **RADIO** phono jack or to pin 2 of the ARB-704 DIN connector. If your radio's amplifier control line uses an RCA phono jack, the ground connection will be made through the shell of the jack. No additional ground connection is necessary if you use a standard shielded audio cable for the connection to the **RADIO** jack on the ARB-704.

### QSK Radio

Some QSK transceivers (mostly early Yaesu's) have a control terminal or jack labeled "Inhibit" or "Linear" that has to be grounded on transmit. Consult the radio manual for details on this particular requirement. This connection prevents hot switching of an external power amplifier, and is normally wired to a "hard-shut" line on a QSK amplifier that tells the radio the amplifier has successfully gone in the transmit mode.

If a radio having this connection is not being used with a QSK amplifier, or is being used with a QSK amplifier without a "hand-shake" or "TX enabled" output, the radio inhibit control line must be connected to the radio's chassis ground. If the amplifier has a "TX enabled" line, or when using an Ameritron QSK-5, connect a jumper cable from the radio "Inhibit" or "Linear" input to the Handshake or "TX Ready" line on the amplifier or amplifier QSK switch.

## ALC

Many radios have ALC inputs. If you want to use the ALC output of an amplifier, connect the radio ALC input directly to the amplifier's ALC output. If you use a plug and play cable connect the amplifier ALC to the ALC phone jack on the ARB-704.

## AMP RELAY

**WARNING:** Do not exceed 200 volts peak voltage or 300 mA current on the ARB-704's AMP Jack. This jack is ground referenced, but will handle AC, positive, or negative amplifier relay voltages.

The Amplifier relay connection is through the AMP phone plug on the ARB-704.

## POWER

A red-black wire pair with matching plug is included with this unit for use with external power supplies. The red wire is positive, and the black wire is negative. The voltage must be between 9 and 18 volts DC. Be sure to properly fuse the red lead with a ½ ampere fast-blow fuse when using high current supplies (capable of over 2 amperes).

- 1.) Connect the red lead (positive center pin) of the power cord assembly to the proper positive DC supply voltage. This voltage must be 9-18 volts positive.
- 2.) Connect the black (negative outer sleeve) lead to the negative of the power supply. It is normally not necessary to fuse this lead, as long as the negative terminal of the station power supply is properly grounded.



**Note:** Receivers or transmitters have several methods of controlling external amplifiers. You can usually find this information in the radio manual section dealing with "External Amplifier", "External Control", "Antennas", or "Rear Panel Connections".

**WARNING:** Do not use the power cord and jack when using power through the rear panel IEM plug!

## TECHNICAL ASSISTANCE

If you have any problem with this unit first check the appropriate section of this manual. If the manual does not reference your problem or reading the manual does not solve your problem, call *Amertone* at 662-323-6211. We can only help if you have your ARB-704 manual, radio manual, and information about your station available during the call.

*We strongly recommend calling Amertone with any questions, but questions can be mailed directly to Amertone at 116 Willow Road, Starkville, MS 39359 or Faxed to 662-323-9840. Please be aware that MFI is a separate facility, and as such does not always offer the best assistance with Amertone products. Be sure to send a complete description of the problem, explain how this unit is being used, and include a complete description of your station.*

